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Message from the Chair

Galen Rathbun
Chair, IUCN/SSC Afrotheria Specialist Group

There will be an entire session on the Afrotheria at the African Small Mammal Symposium (ASMS) in July 2011, in Swaziland. For more details check out their web site: http://www.asms.uniswa.sz/. There will be about 10 speakers contributing papers in the Afrotheria session, with only hyraxes not being represented (along with the larger cousins of course, the elephants and sea cows). One of the plenary sessions will also be focused on the afrotheres. Even if you are still not registered, it is not too late! If enough members from our specialist group attend the symposium, we will try to set up a time when we can meet informally – perhaps over a meal. I look forward to seeing those of you that make it to the meeting.

There are a couple of conservation issues that are getting some broader attention. Dr. Rajan Amin of the Zoological Society of London and his colleagues summarize the increasing problems associated with the biodiversity of the coastal forests of northern Kenya (page 15), where a potentially new giant sengi was found recently (see also Andanje *et al.* 2010 in the Abstracts section, page 19). I have worked closely with our members that focus on golden moles to write a general letter on the increasingly serious conservation status of Juliana's golden mole (see Afrotheria News on page 16).

PJ Stephenson and I have started to discuss assembling a conservation strategy for those afrotheres that carry an IUCN Red List threatened status (i.e. various tenrecs, sengis and golden moles).We hope to have a more specific plan in place soon, but if any of you have thoughts right now, let us know.

Lastly, congratulations to Peter Coals of Oxford University for his success in obtaining funding and organizing an expedition to Mozambique to explore giant sengis there (see Afrotheria News, page 16). Peter received funding from the Chicago Board of Trade, with our specialist group endorsement, which is quite an accomplishment. This is our second successful endorsement out of several. The first grant from the CBOT was to several of our members that focus on golden moles.

G.B. Rathbun
Cambria, California. May 2011.

INSIDE THIS ISSUE

Scientific Articles

The interaction between social status, vocalization and endocrinology in the rock hyrax: an overview of current knowledge

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Introduction and Methods

Rock hyraxes (*Procavia capensis*) are protected throughout Israel, both inside and outside national parks. For that reason, hyraxes are abundant and can be found in large numbers even in cities and smaller communities, on

rocky outcrops and in backyards. Hyraxes cause damage to orchards and gardens by consuming large quantities of fruit and leaves. In places where damage is severe, population culling is applied for short periods of time. Since hyraxes are such agile climbers, it is very difficult to fence against them.

Our research group has been studying a population of free-living rock hyraxes since 1999 in the Ein Gedi Nature Reserve (31°28′N, 35°24′E), which is located west of the Dead Sea in the Judean Desert, Israel. Ein Gedi is a secluded desert oasis that contains several large springs, creating an isolated patch of lush vegetation in the generally arid Syrian-African Rift Valley. Since water is available year round this area supports many species of flora and fauna, including the rock hyrax and its predators (e.g. leopard, striped hyena, gray wolf, red fox and golden eagle).

During the ongoing study we trapped and marked approximately 300 individuals from six social groups that reside in the Arugot Canyon (since 1999) and David Canyon (since 2002). Additional groups have been observed opportunistically. Hyraxes were caught using live box traps placed in natural crevices. Traps were set approximately 90 minutes before dawn and operated until noon, with inspections every two hours. Trapped animals were anesthetized with ketamine hydrochloride (0.1ml/kg intramuscular injection), weighed, measured, photographed, and individually marked using small (1cm) cylindrical subcutaneous transponders (DataMars SA; Bedano-Lugano, Switzerland) that were inserted into the neck region. To facilitate individual identification of the animals from a distance we fit adults with numbered collars (collar weight 5g; range of 0.125% to 0.2% of hyrax body weight). All measurements were recorded in situ and the animals were returned to the traps for full recovery (three hours), and thereafter released at the capture site. Animals resumed full normal activity following their release. Permits for capturing, handling and marking the hyraxes were issued and reviewed annually by the Israeli Nature and Parks Authority.

We recorded behavioural observations using 10x42 binoculars and a telescope with x50 and x75 magnifications. Most observations were in the morning from first light until noon; around midday hyraxes in Ein Gedi retreat to their shelters out of sight. We recorded all social interactions among individuals (all occurrences; Altmann 1974), and specified the initiator, recipient and outcome. For the social hierarchy analysis we considered only agonistic interactions, those that involved display by one individual (i.e. approaching, biting, pushing or chasing) and resulted in an evasive action being taken by a second animal (i.e. running away or retreating from position). We prepared a matrix of encounters for each group using all pair-wise dominance interactions observed during a given field season. For each interaction, the winner (i.e. the hyrax that remained in place or chased away another) and the loser (i.e. the displaced or chased hyrax) were entered. We used David's scores (Gammell *et al.* 2003) calculated annually to rank individuals. We also used hair-testing (Koren *et al.* 2002) to compare individual integrated long-term hormone levels.

Study periods in the field averaged six months each year, from February to August (i.e. a month before parturition until the end of the mating period). This long-term, ongoing research has allowed us a careful examination of life history processes at the individual level, as well as studying social structure and communication between individuals.

Results and Discussion

Age and Morphology

All births at Ein Gedi are in the spring, with pups first observed in March. The birth year for all hyraxes native to the study site is known since they are captured as pups. Body weight (BW) was found to be the best predictor of known age in 89 males and 131 females using linear fit (age was normalized using the Box-Cox transformation; normalized male age = 0.971+1.681BW, $r2=0.925$, $F1,88=1092.6$, $P<0.0001$ and normalized female age = 0.7205+1.9893BW, $r2=0.943$, $F1,130=2147.3$, $p<0.0001$; Koren 2006). Using the above equations, we estimated the age of immigrants and individuals born before our study began in 1999.

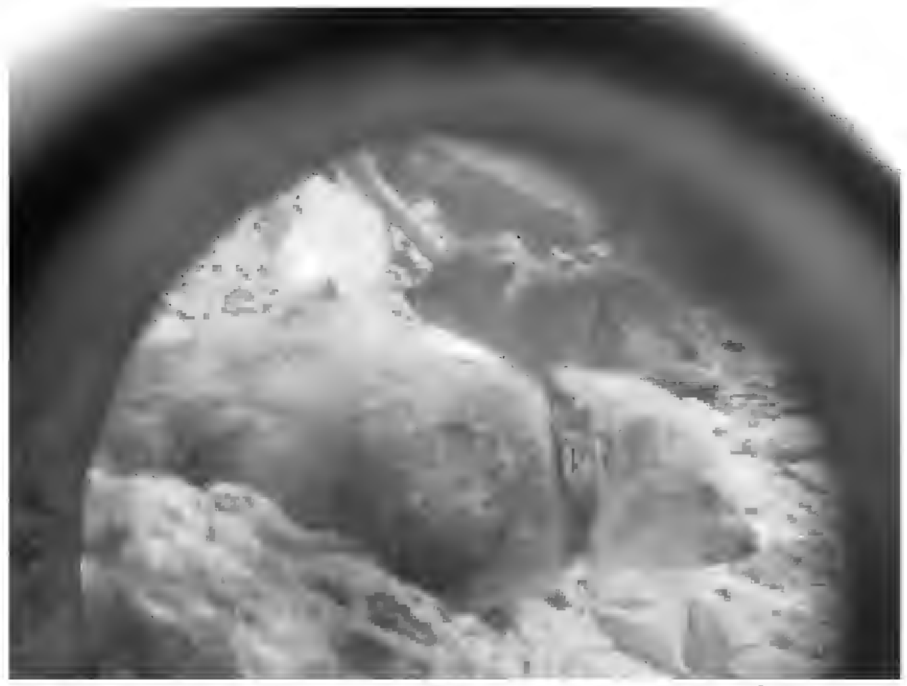

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Figure 1. A marked female rock hyrax and her offspring, photographed through an observation telescope.

Many hyraxes in Ein Gedi have only partial fur coverage, which is caused by an irritation of the skin, mostly on the hindquarters of the animal. We used fur coverage as a proxy for individual physical condition by estimating the percentage hair loss on the back of the animal. Percentage fur coverage was assessed at the time of capture, and verified using photographs. Adult fur coverage ranged between 60-100% (average ± SD=90±12.6%). This remained stable over a field session, throughout successive assessments. The cause of this mange-like condition is unknown, but no evidence of scabies (*Sarcoptes scabei*) or fleas was found (LK, unpublished data). However, at our study site similar hair loss was observed in the Nubian ibex, and attributed to the bites of a louse fly (*Lipoptena* sp; Theodor and Costa 1967), which may also bite the hyrax. Extended skin infections, like mange, are known to influence body condition (Skerratt 2003).

Behaviour and Hormones

Rock hyraxes are mostly diurnal, and at this study site they are relatively habituated, tolerating the presence of stationary humans at ≥10-20 m.

In Ein Gedi hyraxes live in social groups composed of one or two adult males, several adult females (up to 20), juveniles and pups. While females rarely leave the group they were born in, natal males

leave the group when they are 1.5-2 years old and roam as bachelor males. When assessing group hierarchy, taking into account the agonistic interactions, we found that females were the highest-ranking members in the majority of groups (Koren *et al.* 2006). In most groups, the resident male was only ranked second or third after an older female.

Hair-testing showed that females had comparable testosterone levels to males (Koren *et al.* 2006). In mammals, males have been shown to maintain significantly higher testosterone (therefore considered 'the male hormone') levels than females throughout the year and are typically dominant over females. In two different mammalian species, the spotted hyena (*Crocuta crocuta*) and the fossa (*Cryptoprocta ferox*), adult females had elevated levels of other androgens – androstenedione (Glickman *et al.* 1987, Glickman *et al.* 1992, Goymann *et al.* 2001) and dihydrotestosterone (Hawkins *et al.* 2002) respectively - but not of testosterone. Our study demonstrated a distinct exception. To our knowledge, this is the first reported instance of adult female mammals demonstrating higher testosterone levels than adult males.

Further analyses of steroid hormone levels in male and female rock hyraxes showed strong ties between androgens and cortisol in females but not in males, despite the latter being the sex that usually shows this association. We also found a significant interaction between testosterone levels and social status (Koren *et al.* 2006, Koren & Geffen 2009a). Testosterone levels differed only between lower-ranking males and females, with females showing higher levels. Furthermore, dominant females had significantly lower testosterone levels than subordinate females. No association was detected between litter size and female rank, testosterone or cortisol levels (Koren & Geffen 2009a). At this stage we can only hypothesize that the assumed detrimental effects of high circulating androgen levels, reflected in the hair samples, influence the reproductive output or the offspring survival of subordinate females in some other ways, which require further investigation.

Hyraxes communicate vocally with conspecifics using many different types of acoustic signals, including alarm calls, short-range calls, wails, howls, barks and many low intensity chirps and squeaks; especially interesting is the 'singing' of males, which is a rich, complex, loud vocalisation, usually done from an exposed location and heard from a distance. Singing behaviour in our study area starts gradually in February (pre-parturition), peaks in August (mating period), and ceases abruptly thereafter. Singing males were recorded in the morning sessions, when sound propagation is at its peak (Titze 2000). In Ein Gedi, daily strong afternoon winds interfere with sound recordings. Singing is loud and can be heard by humans up to 500 m away. Songs last a few minutes, allowing for the observer to locate and identify the recorded singer. We also noted the time, singer and social situation during which songs were recorded.

In our study site, a third of the adult male hyraxes were identified as singers. We saw that 'singing' males are different from the general adult male population in that their cortisol levels are higher than those of silent males. Only in singers, cortisol levels were associated with social rank, with dominants showing the highest levels. Singers were also on average older and more dominant than most other sexually mature non-singing males (Koren *et al.* 2008). In our study area, mating is synchronous – all adult females mate during a three-week period in summer (July-August) and give birth in March. We observed that females mated not only with the group's male, but also with bachelor males that are not part of the group. We observed that male singers also copulated more (Koren *et al.* 2008), suggesting they have higher reproductive success. Thus, male singing may serve as a self-advertisement, communicating the quality of the singer to both females (potential mates) and rival males.

Communicating individual identity is essential for stable social systems. It is assumed that there are benefits for both senders and receivers to provide and discriminate identity cues (for examples see Koren & Geffen 2009b, 2011). We investigated the possible routes senders use to acoustically broadcast their individual identity. Using discriminant function analysis of temporal and spectral acoustic measurements and analysis of song-element order we explored the means that male rock hyrax singers utilize vocalization to express individual identity. Despite the fact that males use only three song elements, the pattern of acoustic characteristics, their temporal and frequency attributes vary according to the identity of the singer (Koren & Geffen 2011). Individuality in hyraxes is expressed by highly variable, complex signals that are not condition dependent and are stable over years in singers that did not alter their spatial position. We also observed that individuality signals were not linked by relatedness or to a geographic location.

Using detailed spectrogram analysis and a series of multiple regressions we showed that a single complex vocalization by the adult male rock hyrax closely reflects numerous individual traits, possibly encoding various types of biologically important information. Our study reveals that hyrax songs provide accurate information regarding body weight, size and condition, social status and hormonal state of the singer. We also show that these independent data are sent in a sequential manner, a pattern that probably allows a better partition of the messages embedded in the song. Our results imply that animals, through complex individual vocalizations, can potentially advertise multiple individual attributes in the same manner as that produced by chemical scent marking (Koren & Geffen 2009b).

Future Studies

Incorporating genetic analysis of paternity and relatedness, in order to assess reproductive success, can provide the appropriate framework for discussion of ultimate-level mechanisms, complementing our morphological, behavioural and hormonal analysis. The ongoing task of completing the parentage and relatedness analysis for our study population using microsatellite analysis has been immense. Currently we have 12 polymorphic microsatellite loci, yet additional primers are needed since the mean number of alleles (±SD) is 3.8±1.3, and four out of the 12 loci show heterozygote deficiency (Koren & Geffen 2011).

In the future we wish to refine our current understanding of acoustic communication by using controlled playback experiments. We will explore the role of song intensity as a source for information, and analyse other types of vocalisations (e.g. warning trills, pup

screams, and low intensity calls).

Rock hyrax society is an especially interesting model in respect to the interaction between sociality, vocalization and endocrinology. Through our long-term study we accumulated an extensive data set on the association between all individuals in the study area. Negative associations, such as chases and fights, were used to construct a rank hierarchy. We are currently studying positive associations, which are used to construct social networks, describing the relation between individuals and groups. Studying interactions within groups using social networks will advance our understanding of hyrax socialization by revealing the basis for group formation, communication, dispersion and survival.

Acknowledgements

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Les Afrosoricides de la forêt sèche malgache

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Summary (by the Editor)

This paper summarizes the results of a systematic small mammal trapping programme conducted in the dry forests of western and southern Madagascar since the late 1990s. Nine tenrec species were found in the region. Most animals were caught using pitfall traps, although Sherman and National traps were also used. The tailless tenrec, *Tenrec ecaudatus*, and the greater hedgehog tenrec, *Setifer setosus*, were the most common species captured. The lesser hedgehog tenrec, *Echinops telfairi*, and the large-eared tenrec, *Geogale aurita*, were frequently caught, but only south of the River Tsiribihina which represents the northern limit to their distribution. Among the sites surveyed, Kirindy forest had the highest richness of tenrecs, with eight species recorded. Ambavaloza in Kirindy Mite National Park had the highest relative abundance of tenrecs. The rarest species encountered were Jenkins' shrew tenrec, *Microgale jenkinsae*, which is only known from two individuals found at Ankazomafio, in Mikea forest, and Nasolo's shrew tenrec, *M. nasoloi*, which is found only in Kirindy, Analavelona and Vohibasia. The author discusses the distribution and abundance of tenrec species across sites. The main threats facing tenrecs are identified as habitat loss and, with larger species, hunting for meat; the two shrew tenrecs with restricted ranges are considered threatened.

Introduction

Le nombre d'espèces de petits mammifères malgaches

incluant la famille des Tenrecidae (Ordre des Afrosoricida, ex Lipotyphla et ex Insectivora) (Olson & Goodman 2003, Bronner & Jenkins 2005) s'avèrent important depuis 1990 grâce aux plusieurs inventaires et aux différentes études systématiques conduits. Les forêts humides de l'Est sont considérées comme étant plus riches par rapport à celles sèches de l'Ouest. Cette richesse exceptionnelle du versant oriental a longtemps pu être attribuée aux conditions bioclimatiques plus humides (Cornet 1974) qui favorisent l'adaptation de ses animaux dans ce type d'habitats. De plus, un grand nombre de travaux d'inventaire y ont été réalisés durant les dernières années. De ce fait, des inventaires des Tenrecidae ont été effectués d'une façon intensive dans de nombreuses régions forestières de l'Ouest malgache, couvrant en tout 34 sites d'études dans plusieurs types de formation végétale.

Cet article va apporter une synthèse de résultats d'inventaires sur les Tenrecidae malgache dans les différents sites de forêts sèches dans les Domaines de l'Ouest et du Sud malgache. Les données analysées dans cette étude issues des résultats des travaux publiés dans de nombreux sites de forêts sèches malgaches (Soarimalala 2008, Rakotondravony *et al.* 2002, Soarimalala & Goodman 2004, Goodman *et al.* 2002, Goodman *et al.* 1999a,b). Cette analyse pourra dessiner la limite de distribution de Tenrecidae et de définir s'il y a des espèces qui ont une distribution restreinte. Il est aussi important d'approfondir les connaissances sur les menaces qui pèsent ces animaux.

Méthodologie

Plusieurs sites d'échantillonnage qui couvrent une zone s'étalant sur un gradient de 11 degrés de latitude entre 14°S et plus de 25°S ont été prospectés (Fig. 1). Ces sites allant, depuis, du nord au sud, la forêt de Binara-Daraina dans la partie Est, les zones du Parc National (PN) de Sahamalaza au nord-ouest, de la chaîne du Bongolava-Manasamody et du PN d'Ankarafantsika, de la région de Besalampy, du PN de Bemaraha, de la région du Menabe Central, du PN de Kirindy Mite, de la forêt de Mikea, de la partie nord du PN de Tsimanampetsotsa, du plateau Mahafaly, la parcelle 2 du PN d'Andohahela et quelques sites dans la région d'Amboasary-Sud.

Les méthodes de capture choisies durant ces inventaires dans chaque site étudié sont les trou-pièges. Ils sont identiques à ceux qui ont été adoptées à Madagascar depuis près de 20 ans. Les pièges standard (« Sherman » et « National ») qui sont principalement destinés aux rongeurs permettant aussi de capturer de quelques individus de Tenrecinae. En plus de ces deux techniques de piégeage, une enquête entreprise auprès des habitants des villages proche du lieu d'échantillonnage donne aussi des renseignements qualitatifs sur les Tenrecidae. D'autre méthode qui a fourni des informations sur ces animaux est la fouille systématique réalisée par l'équipe herpétologique.

Résultats

Sur les neuf espèces de Tenrecidae recensées dans tous les sites de forêts sèches malgaches, la forêt de Kirindy (Centre de Formation Professionnelle Forestière - CFPF) abrite la diversité la plus élevée (huit espèces). Aucune variation de la richesse spécifique notable n'a été trouvée du nord au sud et la plupart des sites abritent un nombre variant de 2 à 4. Pour ces sites, *Tenrec ecaudatus* et *Setifer setosus* ont été les espèces les plus communément recensées et dans la majorité des cas, elles ont été observées ou signalés par la population riveraine et quelques fois trouvées par la méthode de fouille. *Echinops telfairi* et *Geogale aurita* ont été fréquemment trouvés mais seulement au sud du fleuve Tsiribihina qui constitue la limite nord de leur aire de distribution. D'autres espèces de Tenrecidae étaient plus rares comme *Microgale jenkinsae* qui n'est encore connu que par deux individus trouvés à Ankazomafio, dans la forêt de Mikea) et *M. nasoloi* qui est inféodé aux forêts de Kirindy (CFPF), d'Analavelona et de Vohibasia.

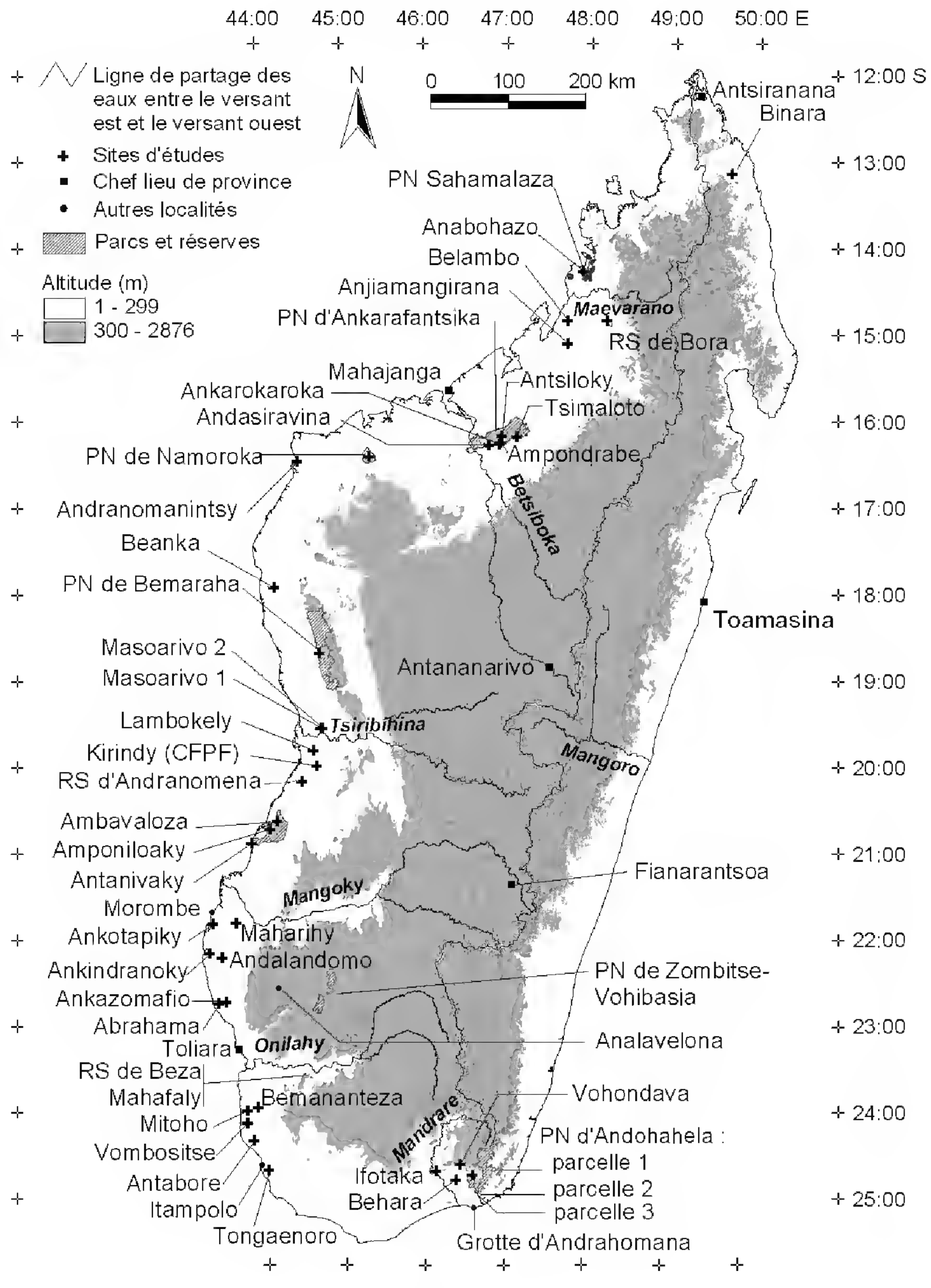

Figure 1. Stations d'échantillonnage de petits mammifères de la région sèche malgache.

L'abondance relative la plus importante des Tenrecidae a été obtenue à Ambavaloza (PN de Kirindy Mite). Les valeurs les plus faibles ont été relevées dans les forêts de Tongaenoro du Plateau Mahafaly et de Vohondava près de Tranomaro. Aucun individu de petits mammifères n'a été capturé à l'aide de trou-piège dans les forêts de Vombositse (PN de Tsimanampetsotsa), d'Ankotapiky (la forêt de Mikea) et du PN de Bemaraha.

Bien que les pièges « Sherman » et « National » soient principalement destinés aux rongeurs, le nombre de *Tenrec ecaudatus*, *Setifer setosus* et *Echinops telfairi* capturés par le biais de cette technique est considérable dans plusieurs sites. Si *S. setosus* est absente ou représente souvent une abondance relative assez faible dans les autres sites, le taux élevé de cette espèce rencontré dans la forêt d'Ambavaloza (PN de Kirindy Mite) est très exceptionnel. L'abondance relative d'*E. telfairi* dans la forêt Mikea et d'Ambavaloza (PN de Kirindy Mite) sont également remarquables. *Microgale brevicaudata* abondait

aussi dans les forêts d'Andranomanintsy à Besalampy et du PN d'Ankarafantsika. Ensuite, bien que *T. ecaudatus* ait une large distribution sur l'ensemble de l'île, aucun signe de sa présence n'a été obtenu dans la parcelle 2 du PN d'Andohahela, ni dans les forêts d'Abraham (forêt de Mikea) ni de Belambo dans le Bongolava-Manasamody. Cette espèce a été capturée en faible abondance dans la plupart des sites inventoriés.

Tableau 1. Liste des espèces de Tenrecidae dans les sites inventoriés de forêts sèches. Toutes les informations sont basées sur les animaux capturés dans les pièges et par la méthode de fouille sauf quelques animaux observés ou signalés par la population riveraine qui sont notés en (+). La présence marquée par [+] indique que cette espèce a été répertoriée grâce aux squelettes trouvés.

Espèces	*Binara-Daraina*[1]	*Anabohazo/ PN Sahamalza*	*RS Bora*	*Belambo*	*Anjiamngirana*	Ankarokaroka[2]	Antsiloky[2]	Tsimaloto[2]	*Andasiravina*	*Ampondrabe*	*PN Namoroka*	*Andranomanintsy / Besalampy*	*Beanka*	*PN Bemaraha*	*Masoarivo 1*	*Masoarivo 2*	*Lambokely*	Kirindy (CFPF)[3,4,5]
Afrosoricida																		
Tenrecidae																		
Tenrecinae																		
Echinops telfairi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Setifer setosus	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	-	+	+
Tenrec ecaudatus	+	(+)	+	-	+	+	+	+	+	+	+	+	+	+	(+)	(+)	+	+
Oryzorictinae																		
Microgale brevicaudata	+	-	+	-	+	+	+	+	+	+	-	+	+	+	+	+	-	+
Microgale grandidieri	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	+
Microgale jenkinsae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Microgale longicaudata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Microgale nasoloi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
Echinops telfairi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Geogalinae																		
Geogale aurita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Nombre total d'espèces	**3**	**2**	**3**	**4**	**8**	**8**	**7**	**8**	**6**	**8**	**3**	**3**	**4**	**4**	**3**	**2**	**3**	**8**

*Espèce introduite à Madagascar. [1]Raheriarisena & Goodman (2006). [2]Rakotondravony *et al.* (2002). [3]Goodman *et al.* (2002). [4]Goodman *et al.* (1999a). [5]Olson *et al.* (2009).

Espèces	*Andranomena*	*Ambavaloza*	*Amponiloaky*	*Antanivaky*	Maharihy[6]	*Ankotapiky*[6]	Ankazomafio[6]	Andaladomo[6]	*Ankindranoky*[6]	Abrahama[6]	Bemananteza[7]	Mitoho[7]	*Vombositse*	*Antabore*	*Tongaenoro*	*Mahavelo*	*Vohondava/ Tranomaro*	*Behara*	PN Andohahela Parcelle 2[8]
Afrosoricida																			
Microgale brevicaudata	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Microgale grandidieri	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Microgale jenkinsae	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Microgale longicaudata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Microgale nasoloi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Echinops telfairi	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Geogale aurita	+	+	-	+	+	-	+	+	+	+	+	+	+	+	-	(+	+	+	+
Setifer setosus	+	+	+	(+	-	-	+	-	(+	-	+	+	+	+	(+	(+	(+)	(+	+
Tenrec ecaudatus	+	+	(+	(+	+	+	+	+	+	(+	(+	+	(+	(+	(+	(+	+	(+	-
Nombre total d'espèces	**4**	**5**	**3**	**4**	**3**	**2**	**5**	**3**	**4**	**3**	**5**	**7**	**6**	**6**	**4**	**4**	**6**	**5**	**4**

*Espèce introduite à Madagascar. [6]Soarimalala & Goodman (2003) [7]Goodman *et al.* (2002). [8]Goodman *et al.* (1999a, 1999b).

Discussion

Diversité spécifique

La richesse élevée dans la forêt de Kirindy (CFPF) confirme la justification de la retenir en tant que refuge pour la faune des forêts sèches de l'Ouest (Sorg *et al.* 2003). Il est également possible de suggérer que sa position géographique et les formations forestières naturelles qu'elle abrite font de ces forêts une zone de transition entre le nord et le sud qui pourrait justifier cette particularité. En outre, les résultats obtenus montrent l'importance de répéter les explorations dans un site car si cette forêt avait fait l'objet d'études sur les petits mammifères pendant plusieurs années (Ganzhorn *et al.* 1996, Raharivololona 1996), l'inventaire conduit vers la fin de la saison des pluies en avril 2006 a permis de rajouter une 13ème espèce, *Microgale nasoloi*, pour cette forêt (Soarimalala & Goodman 2008). Cette espèce était connue pour la première fois dans les forêts d'Analavelona et de Zombitse-Vohibasia, localisées dans la partie Centre-Sud de l'île qui sont considérées comme sub-humides (Jenkins & Goodman 1999, Moat & Smith 2007). D'autres mammalogistes ont également rapporté la présence de *M. longicaudata* dans la forêt de Kirindy (CFPF) (Ade 1996, Hilgartner 2005) mais des études génétiques approfondies portant sur cette espèce ont montré que ce taxon représentait plus d'une espèce (Olson *et al.* 2004) et qu'il est par conséquent vraisemblable qu'il puisse s'agir de *M. majori*. La taxinomie de *M. longicaudata* rencontrée à Kirindy (CFPF) reste donc à préciser et reste en attente des études morphologique et génétique. Néanmoins, il est toujours important de signaler que les *Microgale* à queue longue, à savoir *M. longicaudata* et *M. majori* qui sont largement distribués dans la forêt humide de l'Est malgache n'auraient jamais fréquenté le biome de forêt sèche malgache.

Pour l'ensemble des petits mammifères, la forêt de Mikea semble être le site le plus pauvre en espèces. Il est clair que les conditions climatiques sèches qui règnent actuellement dans cette forêt ne favorisent pas la survie de certains animaux. Plusieurs sites de forêts sèches présentent également un faible nombre d'espèces de Tenrecidae et cette pauvreté semble être en rapport avec la dégradation des habitats naturels que nous avons pu constater au cours des inventaires. Il s'agit plus particulièrement des forêts de Tongaenoro et d'Antabore sur le plateau Mahafaly, de Mahavelo à Ifotaka, de Masoarivo à l'est de Belo sur Tsiribihina, de Belambo dans le Bongolava-Manasamody et de la RS de Bora. Rappelons aussi que la forêt de Masoarivo a été inventoriée pendant le mois d'octobre, qui est encore un mois sec et il est vraisemblable que cette période était trop précoce par rapport à l'activité des animaux. Mahavelo présente un type du substrat très rocailleux, incompatible avec l'emploi de trous-pièges qui est pourtant la méthode la plus efficace pour capturer les Tenrecidae.

Distribution

Les espèces de Tenrecidae les plus communément recensées du nord au sud des forêts sèches de l'Ouest sont *Tenrec ecaudatus* et *Setifer setosus*. *Echinops telfairi* et *Geogale aurita* ont été recensés dans toutes les forêts visitées entre le PN d'Andohahela (parcelle 2) et la forêt de Kirindy (CFPF). Son absence dans les forêts de Tongaenoro du plateau Mahafaly et de Lambokely dans la région du Menabe Central pourrait être expliquée par un faible effectif de sa population. Il est sûr que le niveau important de dégradation de l'habitat dans ces sites ne suffit pas à expliquer l'absence de *Geogale* car cette espèce a même été trouvée dans un endroit ouvert loin de la forêt près de la route menant à Anakao sur la plaine côtière sableuse à 10 km au sud du village. Cette espèce a été également trouvée dans une savane à termitière dont les larves des termites servent des ressources de nourritures (Tingle *et al.* 2003). L'absence de *G. aurita* dans la forêt de Mahavelo s'explique par un défaut de piégeage car il nous a été impossible d'installer des trous-pièges sur ce type de substrat très rocailleux. Par ailleurs, la prédilection de cette espèce pour les types de sols sableux est connue. Dans la région d'Amboasary-Sud, à Behara, par exemple, le taux de capture de cette espèce a été très élevé. Il en est de même de certains sites explorés dans la forêt de Mikea où le substrat est sableux (Soarimalala & Goodman 2004).


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Figure 1. *Echinops telfairi.*

Des études récentes effectuées sur plusieurs individus de *M. brevicaudata* ont révélé la présence d'une nouvelle espèce, *M. grandidieri* (Olson *et al.* 2009). *Microgale brevicaudata* a une large répartition au nord du fleuve de Manambolo jusqu'à l'extrémité nord-est de l'île tandis que *M. grandidieri* a une limite de distribution entre les forêts galeries aux alentours de la rivière de Onilahy et la forêt du PN de Namoroka. Un chevauchement de distribution de ces deux espèces existe dans la région de Bemaraha et Antsalova et la présence en sympatrique connue est les forêts de Beanka, Maintirano (Goodman et al. soumis) et Kirindy CFPF, Morondava (Soarimalala non publié).

Geogale aurita rapporté dans le PN d'Ankarafantsika (Rakotondravony *et al.* 2002) aurait pu être confondu avec un jeune *M. brevicaudata*, car il s'agissait d'un individu nouveau né et donc difficile à déterminer, d'autant qu'aucun autre individu de cette espèce n'a jamais été capturé dans ce parc au cours des explorations suivantes qui y ont été effectuées (Randrianjafy 2003).

Les forêts de Kirindy (CFPF) et de PN de Kirindy Mite représentent les zones que fréquentent en même temps *E. telfairi*, *G. aurita* et *M. brevicaudata*. Ce secteur est une des rares zones de contact entre ces trois espèces. Nous la considérons donc comme une zone de transition entre l'ouest et le sud pour les petits mammifères.

Parmi les espèces rares, *M. jenkinsae* ne se trouve que dans la forêt d'Ankazomafio de la forêt de Mikea. Bien que *M. nasoloi* existe dans les forêts de Zombitse-Vohibasia et d'Analavelona, situées dans la partie Centre-sud de l'île, Kirindy (CFPF) est la seule forêt sèche

occidentale qui l'abrite (Jenkins & Goodman 1999). *M. longicaudata* n'est rencontré que dans un seul site de la forêt sèche malgache (Moat & Smith 2007), à savoir dans la forêt de Kirindy (CFPF) (Ade 1996, Hilgartner 2005).

Aucun modèle lié à la structure de la végétation et le type du sol n'a pu ressortir de nos analyses pour comprendre la variation de la richesse spécifique des Tenrecidae de la forêt sèche malgache du nord au sud. Généralement, la richesse est élevée dans divers sites de forêts sèches caducifoliées sur sable. Toutefois, les forêts sèches caducifoliées du Nord-est, la région de Binara-Daraina n'abritent pas des espèces typiques de la forêt sèche malgache. La seule espèce de forêt sèche de cette région est *M. brevicaudata* et elle est cependant présente dans quelques sites de forêt humide de l'Est comme Marojejy. Parmi les forêts épineuses sur le plateau calcaire, le site de Mitoho (PN de Tsimanampetsotsa) abrite le plus grand nombre d'espèces mais un appauvrissement a été constaté dans d'autres forêts sur le même type de substrat comme les forêts de Vombositse, Antabore et Tongaenoro du plateau Mahafaly. Si aucun cours d'eau ne traverse le fourré épineux de ce plateau, la forêt de Mitoho abrite quelques résurgences d'une nappe superficielle d'eau légèrement saumâtre (Goodman *et al.* 2002).

Malgré la diversité des formations géologiques de l'Ouest malgache avec des types de sols différents, nos analyses ne semblent pas montrer de relation entre la faune de petits mammifères et la géologie et la pédologie. Les forêts sèches caducifoliées sur substrat limono-sableux comme Daraina, Anjiamangirana, Belambo et le PN d'Ankarafantsika n'abritent pas une composition spécifique différente par rapport aux sites sableux, à savoir Masoarivo, Kirindy (CFPF) et le PN de Kirindy-Mite, la forêt de Mikea ou encore par rapport aux sites sur calcaires comme le PN de Bemaraha, le PN de Namoroka et les sites du plateau Mahafaly. Cependant, chaque type de substrat semble montrer une spécificité mais celle-ci n'est pas homogène et n'est pas rencontrée dans toutes les forêts qui poussent sur un même substrat. *Microgale jenkinsae* et *M. longicaudata* dans les forêts sur substrat sableux. Bien que la région de l'Ouest abrite une formation végétale similaire suivant les variations des types de sols et de la géologie, d'autres facteurs tels que la présence des microhabitats particuliers, les microclimats et le degré de la perturbation anthropique pourraient également expliquer une distribution inégale des petits mammifères.

Menaces

Certaines zones forestières de l'ouest malgache ont été largement modifiées par l'homme qui les a transformées en zone d'agriculture et de pâturage. En plus de la destruction des habitats, dans tous les sites visités, les espèces de Tenrecidae de grande taille était sujette au braconnage et elles sont prisées comme « gibiers ». *Echinops telfairi*, *Setifer setosus* et *Tenrec ecaudatus* sont très recherchées pour leur chair qui est fort appréciée. Ces espèces sont chassées pour répondre aux besoins quotidiens mais elles peuvent aussi être collectées massivement et vendues sur les marchés. Dans la plupart des sites, une pratique commune consiste à abattre certains arbres pour collecter des *E. telfairi* et des *S. setosus*, espèces nocturnes, qui sont faciles à trouver dans les troncs d'arbre durant le jour et pendant la période d'hibernation. Ces espèces sont par ailleurs faciles à capturer avec l'aide d'un chien qui n'a d'ailleurs aucune difficulté à creuser leurs terriers. Il serait opportun de mener des recherches approfondies pour connaître le degré de prélèvement par la chasse que ces espèces pourraient supporter. Il est certain par exemple que le degré de la chasse qui est relativement élevé dans la forêt des Mikea a un effet sur la diminution de l'abondance des Tenrecidae (Goodman *et al.* 2004). Dans les forêts humides du Nord-est, il a été montré que le niveau d'exploitation a une grande influence sur la population des animaux chassés (Golden 2005).

Statut de l'IUCN

Suivant la classification de l'IUCN (2010), deux espèces de Tenrecidae fréquentant les forêts sèches de l'Ouest Malgache ont été listées. *Microgale jenkinsae* est considéré comme en danger (EN) et *M. nasoloi* est vulnérable (Vu).

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Can giant sengis (genus *Rhynchocyon*) be captured with baited traps?

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Introduction

The black-and-rufous sengi, *Rhynchocyon petersi*, is one of the four currently described extant species of giant sengi in the genus *Rhynchocyon*. The others are the gray-faced sengi (*R. udzungwensis*), the golden-rumped sengi (*R.*

chrysopygus) and the chequered sengi (*R.cirnei*). Giant sengis weigh between 350g and 710g (Rovero *et al.* 2008) and occur in eastern and central African, where they generally inhabit forests (Rathbun 2009). All giant sengi are known to be invertebrate specialists feeding on whatever they can glean from the leaf litter and soil (Rathbun 1979). Three quarters of *Rhynchocyon* species are threatened (Rathbun 2009).

Various methods have been used to study and understand the status of giant sengis, including determining presence or absence with camera traps (e.g. Rovero & Rathbun 2006), capture of live individuals with fishing nets for morphological studies and individual marking and radio-tracking (Rathbun 1979), and developing abundance estimates based on nest counts (e.g. FitzGibbon & Rathbun 1994). Smaller species of sengis are easily trapped with Sherman traps using most of the common baits used for trapping rodents (e.g. Leirs *et al.*1995, Ribble & Perin 2005, Yarnell & Scott 2006). The objective of our study was to determine if baited traps can be used to capture giant sengis, and to determine which type of bait was most effective.

Material and Method

The study was carried out in Zaraninge forest in the coastal, south-western section of Saadani National Park, Tanzania ($6^0$04′S-$6^0$13′S and $38^0$35′E-$38^0$42′E; Fig. 1).

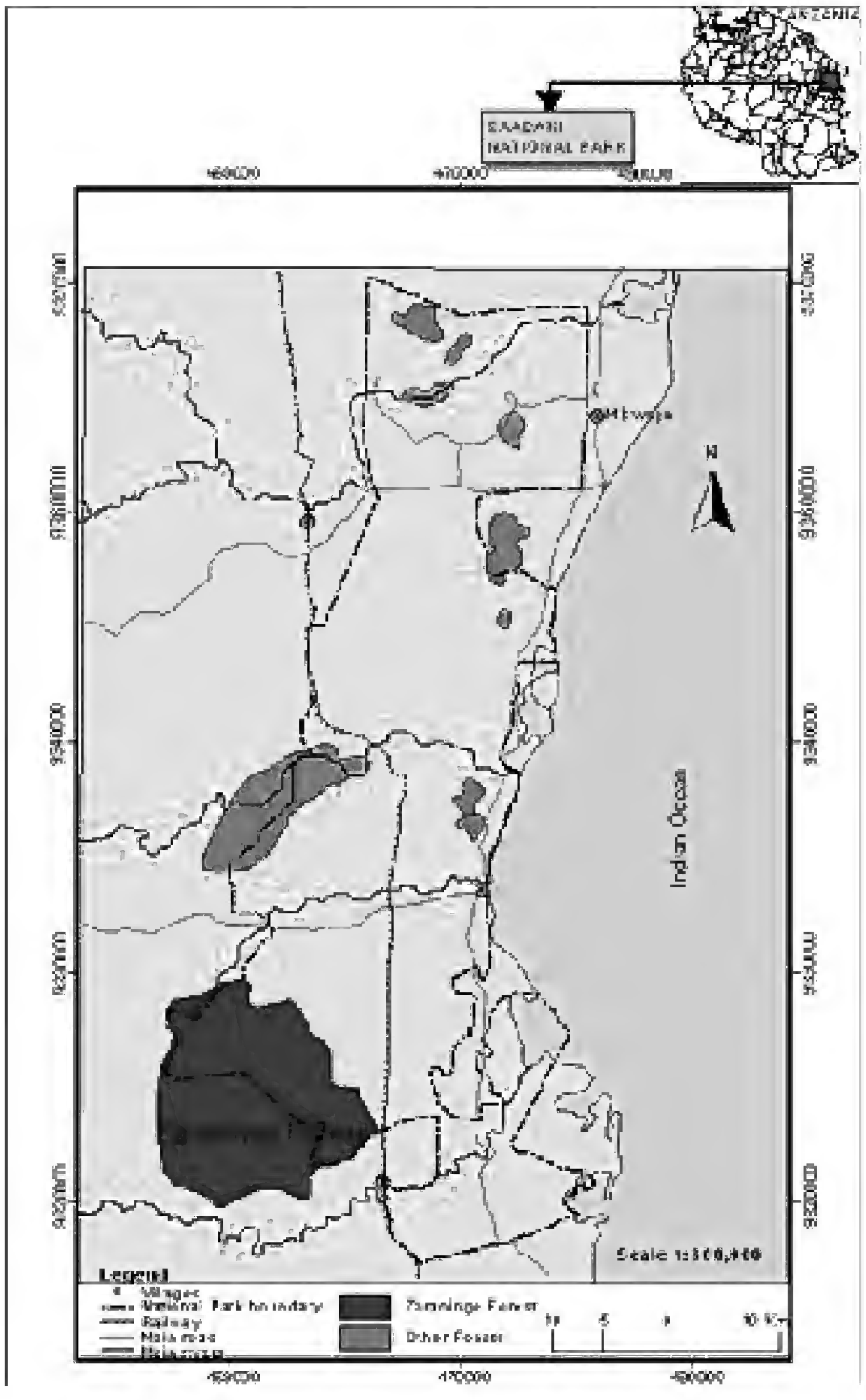

Figure 1. Map showing Saadani National Park and the study site, Zaraninge Forest.

The dry, evergreen forest covers about 174 km^2 on a plateau that rises 300 m above sea level (Clarke & Dickinson 1995). We trapped during the dry season from the end of July to early September, 2009.

Before trapping we visually surveyed the area for sengis, their nests, and possible sengi paths. Five sites were selected at least 500m apart. Seventy traps of two types were employed in this study: Harvahart traps (15) and locally made wire cage traps (55). A locally made wire cage trap (60 x15 x 170 cm) is essentially a tunnel with a door at one end which opens out wards and is held by a hanging wire loop. The bait may be hung on this loop or put a distance behind the loop on the floor of the trap. An animal entering the trap knocks the loop and the door is released and held tight by a spring supported with a wire lock (Fig. 2).

We used four types of bait: 1) a mixture of peanut butter, maize flour and ripe banana; 2) a mixture of sugar, maize flour, and water; 3) chopped cockroaches and termites; and 4) *dagaa* (small sun-dried fish). The peanut butter mix (the most common bait used in trapping rodents) was placed in ten traps, the *dagaa* in twenty traps, the sugar mix in plastic containers in twenty traps, and the cockroach and termite mix in twenty traps. All traps were moved from one site to another every five nights until all five sites had been trapped. Traps were baited in the morning and checked and re-baited at 5.00 pm to avoid disturbance of the diurnal sengi's activities.

All trapped individuals were individually marked by fur clipping and released at the capture location.

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Figure 2. Locally made wire cage trap, camouflaged with leaf litter.

Results

A total of 37 individuals representing seven species of small mammals (Table 1) were captured in 1750 trap nights (a trap-night is a single trap set for a 24-hour period).

No giant sengis were caught, but five four-toed sengis (*Petrodromus tetradactylus*) were captured (Fig. 3). The most common mammal captured was the giant pouched rat (*Cricetomys gambianus*) which preferred the peanut butter mix. This bait also attracted lesser pouched rats (*Beamys hindei*), narrow footed woodland mice (Grammomys *sp*), bush squirrels (Paraxerus *sp*) marsh mongooses (*Atilax paludinosus*) and the four-toed sengis. Traps baited with the sugar mixture attracted numerous insects (mainly cockroaches and ants), and *P. tetradactylus*

was captured in these traps. No mammals were captured in the traps baited with cockroach and termites, and in *dagaa* baited traps only the common genet (*Genetta genetta*) was caught.

Table 1: Live-trapping success for small mammals using different bait

Type of bait	Species	No. individuals captured
Peanut butter mixed with maize flour and ripe banana	*Cricetomys gambianus*	12
	Beamys hindei	6
	Grammomys sp.	4
	Paraxerus sp.	4
	Petrodomus tetradactylus	2
	Atlax palidinosus	2
Sugar mixed in water with maize meal	*Petrodomus tetradactylus*	3
Dagaa (sun-dried small fish)	*Genetta genetta*	4
Cockroaches and termites	-	0
TOTAL		37

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Figure 3. *Petrodromus tetraductylus* trapped with a Havahart trap in Zaraninge forest, Saadani National Park.

Discussion

Identifying the presence or absence of *R. petersi* in the forest sites was easy compared to the effort involved in catching them using baited traps. The results of this study demonstrated that there was no positive response of *R. petersi* to any of the baits we used. However, other species responded differently to different baits. The capture of *P. tetraductylus* could be due to the animals being attracted by the insects attracted to the different baits, or it was trapped as an accident, or the trap was placed along its common path. Other studies, including that being initiated by F. Rovero (*person communication*), are successfully using un-baited cage traps to capture *R. udzungwensis*. This method involves placing traps along indistinct paths through dense undergrowth, which are sometimes used by *Rhynchocyon* (California Academy of Sciences 2011). Sabuni (2008), in his study of small mammals in Saadani National Park, captured only two *R. petersi* (Fig. 4) and one *P. tetraductylus* out of 375 trap-nights of effort. These sengis were captured in locally made wire cage traps baited with peanut butter mixed with maize flour and ripe banana. Perhaps this success was due to luck, when the animals entered the traps accidentally and were not attracted by the bait. Our results, and the fact that giant sengis feed strictly on invertebrates by gleaning leaf litter and soil, suggest that they do not scavenge and they may be poorly adapted at detecting food items not normally encountered in their habitats. Interestingly, in captivity black and rufous sengis do adapt to a diet of dried cat food with some crickets, mealworms, and nutritional supplements (Baker *et al.* 2005), which means that under certain environment conditions, giant sengis can adapt to a diet other than only invertebrates.

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Figure 4. A *Rhynchocyon petersi* trapped in a locally hand-made wire cage trap in Zaraninge coastal forest, Tanzania, in an earlier study.

Should we continue to search for and develop baits for giant sengis? Based on past efforts, our data described in this paper, the success of using nets and un-baited traps, and their likely life history, perhaps it is not worth further research.

Acknowledgments
We thank the Tanzania Wildlife and Research Institute and Tanzania National Parks for approval of our study and issuing us permission to work in Saadani National Park, the VLIR for financial support, and our field assistants Ramadhani Kingunguli and Shabani Lutea.

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Review

A summary of the social system of the round-eared sengi

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Constructing a generalized framework for the evolution of monogamy has proven to be difficult because apparently there is no single evolutionary pathway monogamy has taken in all species (reviewed in Reichard 2003). Monogamy should theoretically only evolve when males are unable to realize any polygynous situation or when they achieve greater reproductive fitness, such as engaging in parental activities.

In sengis, all 17 species are believed to be pair-living (Rathbun 2009), but detailed information on the social organisation is available for only six species: the golden-rumped sengi, *Rhynchocyon chrysopygus* (Rathbun 1979, FitzGibbon 1995, 1997), the rufous sengi, *Elephantulus rufescens*, (Rathbun 1979), the rock sengi, *E. myurus*, (Ribble & Perrin 2005), the bushveld sengi, *E. intufi*, (Rathbun & Rathbun 2006), the short-snouted sengi, *E. brachyrhynchus*, (Leirs *et al.* 1995; Neal 1995, Yarnell *et al.* 2008) and the four-toed sengi, *Petrodromus tetradactylus*, (FitzGibbon 1995, 1997, Oxenham & Perrin 2009). Although the social organisation has been confidently confirmed in these studies, the reason for social monogamy in sengis has not been demonstrated.

The present study investigated the social system of the round-eared sengi (*Macroscelides proboscideus*), a small-bodied omnivorous mammal (Sauer 1973, Kerley 1995) occurring in arid and semi-arid regions of South Africa, Namibia and Botswana (Skinner & Smithers 1990). The study was performed in the Goegap Nature Reserve, a semi-desert region in South Africa. Data were collected over three successive breeding seasons and one non-breeding season using mark-recapture, radio-tracking, and observation of free-ranging individually identifiable animals over a period of 2.5 years (for details see Schubert 2006, Schubert *et al.* 2009 a, b).

Population density ranged from 1.59 to 0.35 id/ha, adult sex ratios were near parity and the population was characterized by a lack of sexual dimorphism in body mass (Schubert *et al.* 2009a). Generally, female round-eared sengis maintained areas that had little overlap with neighbouring females in breeding and non-breeding season. Each male pre-dominately overlapped with the home range of a single female. Generally, inter- and intra-sexual overlap with neighbouring individuals was low. Pairs were perennial and territories were maintained year-round. Body mass of male and female round-eared sengis did not predict home range sizes. However, males generally maintained significantly larger areas than females. Furthermore, male but not female territories were sensitive to population density. At higher density males used smaller areas than at lower population density suggesting that male space seems to be primarily limited by the presence of adjacent males. In addition, overlap with neighbouring males was significantly reduced in the breeding as compared to the non-breeding season for males. This may indicate that male territoriality may function as a form of mate guarding. Some pair-living males intruded into the areas of adjacent widowed females. Whereas only one male was able to achieve polygyny, because his female mate also intruded into the widow's area, the majority of paired males shifted back to their original area and female mate, following the intrusion of another unpaired male into the widows' areas at the same time.

Females reproduced 2-3 litters during a long breeding season lasting approximately nine months with an asynchronous birth interval between neighbouring females favouring pre-copulatory and oestrus mate guarding by males (Schubert *et al.* 2009b). During pre-oestrus females were observed to rub their ano-genital region on the ground. Males over-marked their females' scent while following, possibly for concealing the females' reproductive state and advertisement of the paired status. Mate guarding incurred costs for males, because, overall, they lost about five percent of their body mass. On the individual level, male body mass loss was negatively related to the intensity of mate guarding during the pre-copulatory period. Furthermore, guarding was inversely correlated with male body mass in the pre-copulatory period and with the number of neighbouring males during oestrus, indicating that males vary their guarding effort in relation to their physical capabilities and the competitive environment (Schubert *et al.* 2009b).

Pair-living is the predominant social organisation in round-eared sengis from the semi-desert in South Africa; this may have been favoured by year-round territorial females occupying exclusive areas. The reason for the evolution of monogamy in round-eared sengis is

still unclear. Social systems are rarely attributable to a single factor (Sandell & Liberg 1992). In round-eared sengis female dispersion may be a perquisite for the evolution of monogamy. Additionally, male mate guarding may play an important role. Since females reproduced asynchronously during a long breeding season and advertised their reproductive status by scent-marking, males may pursue two behavioural tactics: Engaging in mate guarding for ensuring paternity and also in extra-pair attempts with neighbouring females, possibly for increasing their reproductive success. Since both male tactics present a costly investment of time and energy they may serve as signals of quality providing only higher quality males with the opportunity to enhance their reproductive success, which in turn may be advantageous for females in terms of genetic benefits.

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Photo Essay

Aardvark hunt in Kenya

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While teaching science as a Peace Corps Volunteer at Mirogi Secondary School in South Nyanza District of Kenya (near the south shore of Lake Victoria), I observed the local residents hunt an aardvark. Although it is known that aardvarks are eaten throughout Africa, there is little published on traditional hunting methods.

In April 1968 the secondary school students interrupted a biology class and said that some local men had located an active aardvark burrow and were going to spear it. We decided to observe the process…….

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Figure 1. The area was a gently rolling open savanna woodland with a moderate density of subsistence farmers. A small group of young men had located an active burrow not too far from a small seasonally flooded depression in the landscape that held some standing water. The plan was to dig a ditch between the pond water and the aardvark burrow, then flood the burrow and spear the aardvark as it tried to escape.

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Figure 2. The ditch was dug with "jembes" (large hoes) – about a 100 metres long and 30-odd cm deep.

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Figure 3. Once the ditch was completed, the water was allowed to flow into the ditch.

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Figure 4. However, the water was dammed just short of the burrow until the ditch was completely full. Then, the dam was removed, quickly flooding the aardvark burrow.

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Figure 5. As the burrow quickly began to fill, a pair of hunters with spears ready listened at the burrow entrance for the aardvark....and they waited...and waited.

After a couple hours, there was still no sign of the aardvark and the students and I had to return to the school compound nearby. The hunters kept at it, diverting more water and waiting. They eventually succeeded in spearing the aardvark, which was butchered among the hunters' families. I managed to salvage the skull, which was deposited in the collection of the National Museums of Kenya in Nairobi.

Afrotheria News

Conservation concerns for Afrotheria in northern coastal Kenya

The biodiversity of northern coastal Kenya up to recently has remained poorly understood because security problems and poor infrastructure have discouraged access to the area. However, the wooded areas in the region have great potential for harbouring unique and rare species, including several afrotheres.

Recent improvement in security has allowed systematic camera-trap surveys in the largest forest patches of over 2,000 km^2 within the Boni, Dodori and Lunghi reserves, which are between the Tana River and the Somali border. Among the Afrotheria documented so far are elephants (*Loxodonta africana*), the aardvark (*Orycteropus afer*) and, in coastal waters, dugongs (*Dugong dugon*). Three species of sengi (Macroscelidea) are also found in the area. The ranges of the rufous sengi (*Elephantulus rufescens*) and four-toed sengi (*Petrodromus tetradactylus*) have been expanded into the region.

Although the golden-rumped sengi (*Rhynchocyon chrysopygus*) of coastal Kenya south of the lower Tana River was assumed to occur in the Boni forest region, this now appears to be incorrect. The *Rhynchocyon* east of the lower Tana River rather resembles taxa found hundreds of kilometres to the south (Andanje *et al.* 2010; Fig. 1).

The Boni-Dodori forests also have perhaps the largest population of the critically endangered Aders' duiker (*Cephalophus adersi*) (Fig. 2) (Andanje *et al.* in press), in addition, to important populations of African wild-dog (*Lycaon pictus*) (Fig. 3), cheetah (*Acinonyx jubatus*), lion (*Panthera leo*), and hippopotamus (*Hippopotamus amphibius*). The coastal strip is an important nesting site for three species of marine turtles. The region is also home to the indigenous Boni people, which today only number a few hundred.

Figure 1. Potential new species of giant sengi (*Rhynchocyon*) caught on camera traps

Despite their conservation importance, these coastal forests are being degraded. Now that security issues are improving in the area, there is an urgent need to instigate more active protection, which has been largely absent until now. Land clearance for agriculture, and unsustainable use of forest resources such as tree felling for charcoal, are ongoing problems. This is likely to increase significantly if massive development plans for a railway, a new deep water port and an airport in near-by Lamu island proceed.

The new Kenyan constitution is devolving power and decision-making to local authorities. The current two types of reserves are administered under different authorities, with Boni and Dodori national reserves enjoying Kenya Wildlife Service (KWS) protection, while the Boni and Lunghi forest reserves are administered by the county councils of the Lamu and Ijara districts, and thus are less protected. As a result, the forest reserves seem to endure the brunt of deforestation, degradation and mismanagement, which is all too widespread in Kenyan coastal forests. There is also significant risk from agricultural development, including proposed land acquisition by foreign governments for maize production. There is also a serious threat to forest habitats from the clearance to make way for *Jatropha* 'bio-fuel' plantations, despite the likelihood that *Jatropha* will not grow well here.

Figure 2. Aders' duiker caught on camera traps during recent surveys by the team

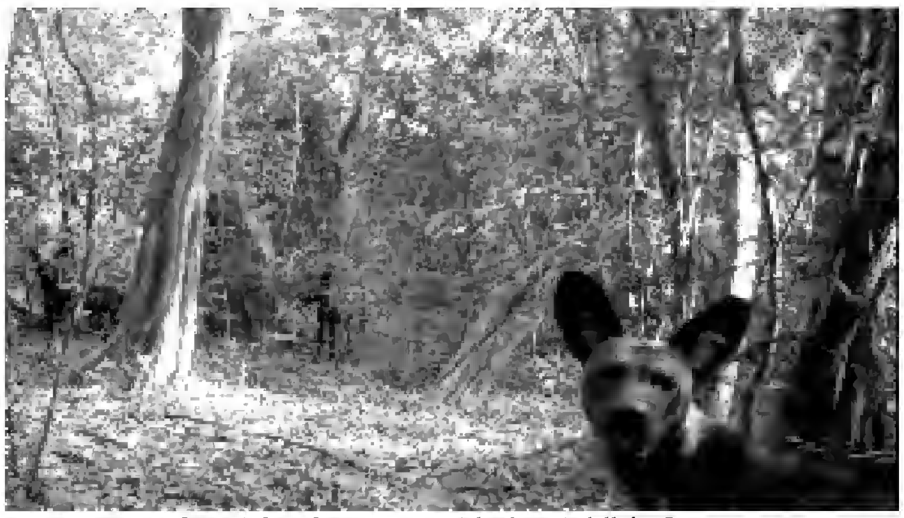

Figure 3. An important wild dog population occurs in the Boni-Dodori Forests

The KWS and key stakeholders are in the process of initiating an integrated ecosystem-based management plan that is crucial to ensure agreement, stakeholder support and participation in protection, restoration and conservation of these remaining northern Kenyan forests, which support a significant number of afrotheres.

We greatly appreciate the field support and participation of the National Museums of Kenya, University of Nairobi, Nature Kenya, Paignton Zoo, and the Whitley Wildlife Conservation Trust. Camera trap images are courtesy of these organizations and those of the authors

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Afrotheria Group chair asks for more help for Juliana's golden mole

The following letter was sent to our colleagues in South Africa for their use as they see fit in trying to achieve some meaningful conservation of Juliana's golden mole, a species of special concern to this specialist group.

MEMORANDUM

Date:	*30 October 2010*
To:	*To Whom It May Concern*
From:	*Galen B. Rathbun, Chair, IUCN Afrotheria Specialist Group*
Subject:	*Juliana's Golden Mole*

In recent years, several members of our IUCN (International Union for Conservation of Nature) Afrotheria Specialist Group have expressed serious concern about the conservation status of the Vulnerable Juliana's Golden Mole, Neamblysomus julianea. *We continue to be concerned.*

The population of Juliana's Golden Mole that occupies the slopes of the eastern Bronberg Ridge, and particularly the deeper sands of the Shere and Zwavelpoort areas on the north-facing corridor between the length of the Bronberg ridge and a provincial road, is Critically Endangered. This corridor, and the greater Bronberg/Shere/Zwavelpoort area, have been radically transformed during the past two decades, largely due to uncoordinated and rapid urbanisation. This area is not only critical for the golden mole, but also supports other Threatened species, and is an important part of the local ecosystem because it recharges watersheds, groundwater, and wetlands. It also provides wildlife habitat, including dispersal corridors and essential areas for pollinators.

We understand that the South African Depart-ment of Environmental Affairs and the South African National Biodiversity Institute have added the greater Bronberg area to an official 2009 list of 'threatened ecosystems', which will soon be promulgated into legislation. We are grateful for this interest and action, and fully support it.

However, to ensure the long-term protection of the unique area, including the golden mole, and to reduce cumulative adverse impacts to the ecosystem, we urge the relevant authorities and interest groups to draft a strategic biodiversity conservation plan.

If our Specialist Group (www.afrotheria.net) can be of any assistance in developing effective protection for the golden mole and its habitat, please feel free to contact me. In the meantime, thank you for your consideration.

We will keep you informed of any developments.

Sengi research in Mozambique

The giant sengis (*Rhynchocyon*) of the coastal forests of northern Mozambique are, in contrast to many of those found in regions further north in Tanzania and Kenya, poorly documented and largely unknown, despite the fact that the first giant sengi to be described (*Rhynchocyon cirnei*) came from Quelimane in Mozambique. In 2010 I was able to photograph an individual in the Mareja reserve, Quirimbas National Park, which appears to differ in pelage from the Quilimani specimen and other *R. cirnei* in the surrounding regions. Indeed in Corbett and Hank's (1968) largely definitive account of sengi taxonomy it is suggested that *Rhynchocyon* north of Quilimane may represent a different subspecies. This issue has not been addressed so far due to lack of specimens.

Dr Galen Rathbun (with his wealth of experience in sengi biology) and I shall spend three weeks in the coastal forest of northern Mozambique in order to collect *Rhynchocyon* voucher specimens and tissues for DNA analysis at the California Academy of Sciences so that the taxonomic status of giant sengis in Mozambique may be better defined. Increasing knowledge of the taxonomic status of sengis in these forests threatened by illegal logging, poaching and infrastructure development is necessary before any meaningful conservation of species and habitats can be conducted. We hope that this work will both aid the resolution of the taxonomic status of giant sengis in Mozambique and contribute to their conservation in the region.

This work is endorsed by the California Academy of Sciences, the University of Oxford and the Royal Geographical Society (with IBG), and is kindly supported by the Chicago Zoological Society's Chicago Board of Trade Endangered Species Fund, the Duke of Edinburgh's Trust, The Explorers Club, and the Society of Biology.

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Aardvark killed by aircraft

The following information was received from Albert de Hoon of Wildlife Strike Prevention, South Africa:

On 16 July 2010 at 1715Z flight SA1107, a de Havilland Dash 8 with registration ZS-NLY, collided with a wild animal

(an aardvark) shortly after touchdown on runway 20 at Kimberley aerodrome in South Africa. The accident occurred at night. The impact was on the nose landing gear, which caused the nose gear to collapse backwards. The pilot managed to maintain runway heading and the aircraft came to rest approximately 1 200 m from the threshold of runway 02 on the centreline.

No passengers were injured, but the aardvark was killed. The full accident report is available at: http://www.caa.co.za/resource%20center/accidents%20&%20incid/reports/2010/8805.pdf

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Non-invasive assessment of reproductive and adrenocortical steroid hormones in captive aardvarks (*Orycteropus afer*)

The aardvark (*Orycteropus afer*) is the only surviving representative of the Order Tubulidentata and an obligate myrmecophagous mammal, which is an animal whose diet consists of over 90% ants and/or termites (Knöthig 2005, Taylor 2005). Currently the group of obligate ant/termite-eating mammals includes four species of anteaters, seven species of pangolins, several armadillo species, the short-beaked echidna, the numbat, the aardwolf, and the aardvark (Redford 1983).

The aardvark seems widely distributed on the African continent due to its wide habitat tolerance, but shows preference for open woodland, and sparse shrub and grassland. Aardvarks are predominantly nocturnal, but occasionally crepuscular in winter (Burger 2004, Taylor 2005, Stuart & Stuart 2006). Aardvarks excavate extensive burrow systems for shelter, which are often refuges for a variety of other animals. They are able to break and penetrate the hard crusts of termite mounds and thereby facilitate the supplementary feeding of other species, like the aardwolf or ant-eating chat, which are not able to open such mounds (Taylor & Skinner 2000, Knöthig 2005, Taylor 2005). Old excavated mounds are also utilized by various species as hibernation or nesting location, which underlines the ecological importance of aardvarks (Taylor & Skinner 2000, Cilliers 2002, Knöthig 2005, Taylor 2005).

The social system of the aardvark is considered to be solitary and the mating system probably polygamous (Taylor 2005). Mean gestation period in captivity has been recorded as 243 days (range 235-258 days) and there are indications of female parental care. In the wild, births may be seasonal and co-ordinated with the rains (Stuart & Stuart 2006, Taylor 2005). In captivity, 1-2 young have been born in all months of the year with peaks in February, March and June (Taylor 2005). According to the International Species Information System (ISIS), a total of 69 individuals are currently kept in zoological institutions worldwide. In Europe, 30 individuals are kept in 12 different EAZA (European Association of Zoos and Aquaria) listed zoos and animal parks. An exchange of animals between the American and European population, or imports from the wild, seem to be inevitable in the near future to avoid problems related to inbreeding (ISIS species holdings, Schoo 2009).

Due to their role as important predator of colonial insects in the ecosystem in which they occur, and their indirect contribution to facilitate the environment for other species, aardvarks can be seen as key species in their ecosystem. Hence, it is surprising that very few data about the life history requirements of these dietary specialists exist. Such information would be helpful to protect the vitality of their ecosystems in the wild and could also help to improve management and welfare of aardvarks in captivity. In particular, it could support the rearing of these nutritional specialists´ offspring, a process which is known to be difficult under management conditions (Parys, pers. comm.). In this regard, hormones of gonadal and even adrenal origin are known to play a regulative role in determining the onset and termination of reproductive activities and, therefore, an animal's endocrine status can function as a viable indicator for monitoring, for example, reproductive related events. Thus, information derived from endocrine studies would help to better understand the influence of socioecological factors and putative stressors on an animal's reproductive behaviour and success.

One key approach to understand the regulative endocrine mechanisms of an animal's reproductive and social behaviour is the non-invasive analysis of gonadal and adrenocortical steroid hormones, which has become an established and widely accepted technique as practical and welfare implications of collecting blood samples from intractable and endangered animals have been recognized (e.g. Schwarzenberger 2007, Hodges *et al.* 2010). In light of this, aardvarks held in captivity would be ideal research subjects to start with, as frequent faecal sample collection is possible and therefore long-term studies, combining behavioural observations and non-invasive hormone monitoring, can be carried out. Consequentially, once established and reliably validated, these techniques for the assessment of gonadal and adrenocortical endocrine function will be important research tools for studying free-ranging animals within their natural habitat and subsequently for the future management of wildlife populations.

Against this background, we initiated a study in 2010 to evaluate non-invasive methods for assessing reproductive and adrenocortical steroid hormones in captive aardvarks by measuring faecal androgens, progestagens, estrogens and glucocorticoid metabolite concentrations. The ongoing study will be conducted on 20 male and female aardvarks kept in the following two AZA (Association of Zoos and Aquariums) and five EAZA accredited zoological institutions: Antwerp Zoo (Belgium), Berlin Zoological Garden (Germany), Brookfield Zoo (USA), Burgers' Zoo (Netherlands), Frankfurt Zoological Garden (Germany), Memphis Zoo (USA) and Saarbrücker Zoo (Germany). For the necessary faecal sample collection as well as for detailed information on housing and management conditions, the project relies to a large degree on the active participation of the above mentioned zoos and animal parks and their staff. The anticipated total duration of the project is 12-15 months and regular sample collection at the European zoos started in September-October 2010 and is ongoing. The required faecal material from animals housed at the two US based zoological institutions have already been

collected from 2002 onwards. Collected faecal samples will be extracted using standard protocols (e.g. Ganswindt *et al.* 2010) and subsequently, various enzyme immunoassays will be carried out to measure the respective reproductive (oestrogen, androgen, progestagen) and adrenocortical (glucocorticoids) steroid hormone concentration in the faecal samples of the monitored individuals. In addition, high performance liquid chromatography or gas chromatography-mass spectrometry will be performed, if required, to validate the specificity of measurement by determining the presence and relative abundance of different steroid hormone metabolites in aardvark faeces.

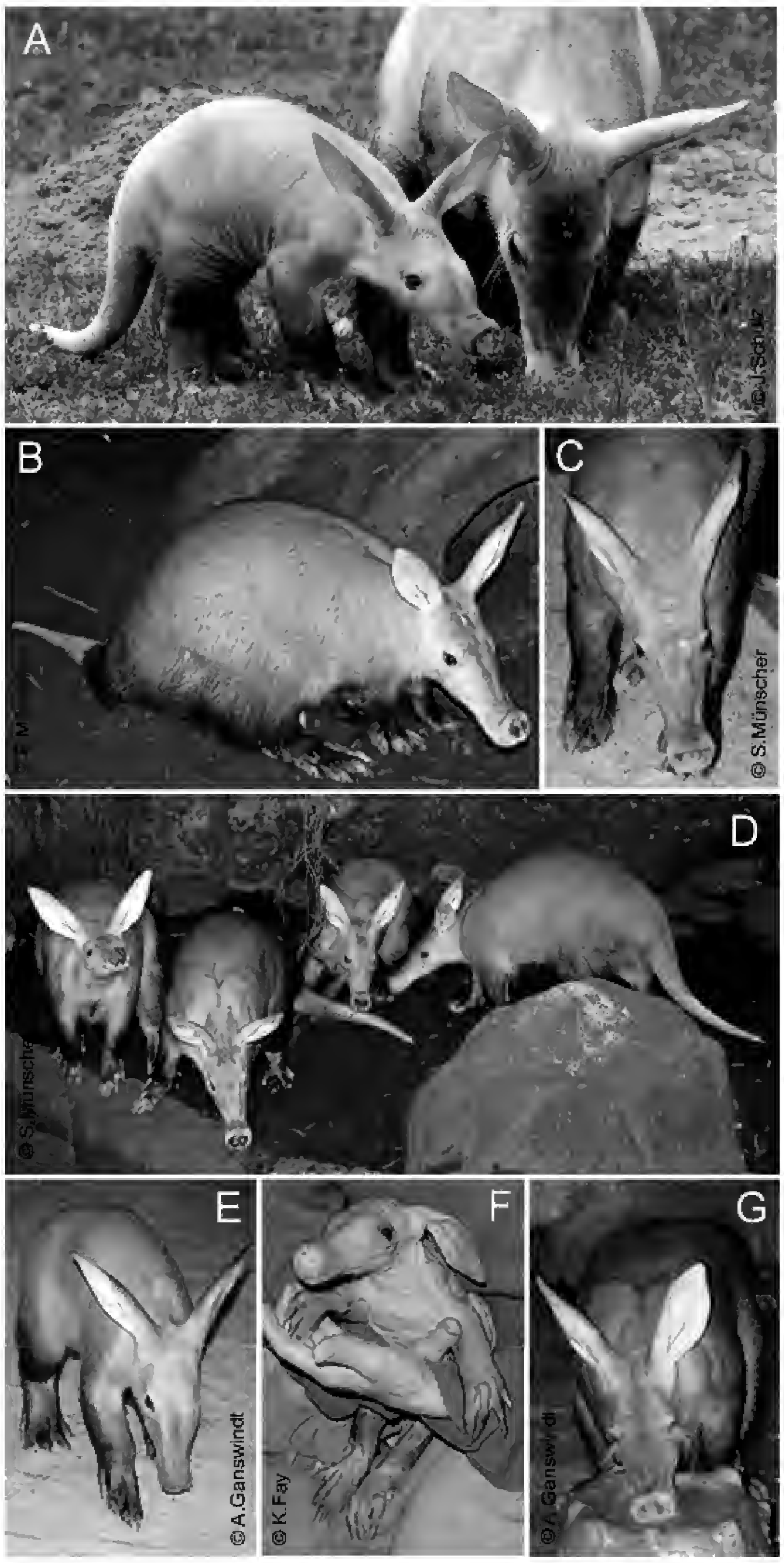

Figure 1. Aardvarks kept at Brookfield Zoo (A), Antwerp Zoo (B), Saarbrücker Zoo (C), Burgers' Zoo (D), Berlin Zoological Garden (E), Memphis Zoo (F), and Frankfurt Zoological Garden (G).

The study is an international project and currently involves, in addition to the above listed zoos and animal parks, the following scientific institutions: University of Pretoria (South Africa), Senckenberg Research Institute and Natural History Museum Frankfurt (Germany), Chicago Zoological Society (USA), and the German Primate Centre (Germany).

Finally, we would like to take the opportunity to thank Andy Kouba, Astrid Bellem, Jocelyn Bryant, Diane Gierhahn, Mary Schollhamer, Thomas Wilms, Richard Francke, Sander Hoffman, Francis Vercammen, Wineke Schoo, Simone Kools, Heiner Klös, Michael Heistermann, Andrea Heistermann, and Stefanie Münscher for their time, effort and cooperation to get the study off the ground.

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Noticeboard

Announcing the WCPA-SSC Joint Task Force on Biodiversity and Protected Areas

After many years in the gestation, we're happy to announce that WCPA and SSC have launched a joint task force to address the interface between species and protected area conservation. For the current quadrennium, the task force has two objectives:

1. To conduct a meta-study to elucidate which factors increase the probability of protected area success in safeguarding biodiversity, especially of threatened species. This will require compilation and comparison of time series population and status data for species inside compared to outside protected areas.
2. To facilitate a process to consolidate the global standards and criteria for the identification of sites of biodiversity conservation significance, as targets for protected area expansion and management, building on nearly three decades of work in systematic conservation planning and practice, and drawing on IUCN's power to convene scientific stakeholders to generate conservation standards (as demonstrated by e.g., the IUCN Red List, the PA management categories).

The Terms of Reference of the joint taskforce is posted on http://www.iucn.org/biodiversity_and_protected_areas__taskforce in the three official IUCN languages. The summary work plan can be downloaded on http://cmsdata.iucn.org/downloads/ssc_wcpa_summary_workplan.pdf

If you have substantive contributions to make to either or both of the taskforce's two objectives, please visit http://groups.google.com/group/wcpassc-joint-task-force/about, where you can register to join the task force, stating what contributions you are particularly interested in making.

We look forward to broad engagement of WCPA and SSC with this important taskforce.

Simon Stuart
Chair, IUCN Species Survival Commission
Nik Lopoukhine
Chair, World Commission on Protected Areas

Funding opportunities

The Chicago Zoological Society administers **the Chicago Board of Trade (CBOT) Endangered Species Fund**, which supports conservation-oriented research. The grant attracts dozens of innovative research projects each quarter, and the most promising of these are awarded funding.

The CZS CBOT Endangered Species Fund is now accepting new proposals but please note that the application process has changed and only online submissions will be accepted. .

In general, the Society's CBOT Committee wishes to have grant funds applied to the following types of actions: Projects that will assist directly in the protection of populations of threatened and endangered species; or a specific habitat that is of high biological value or that is substantially threatened (IUCN Red List Status). This includes projects that will quantitatively assess population and environmental status with indications of best conservation strategy; projects that will help achieve sustainable relations between local people, and the species of concern. The development of educational projects and training that assist in building local conservation capacity are given higher priority.

The Fund will support small projects usually up to US$5,000 (smaller requests will fare better).

Grants are open to SSC Specialist Group Chairs and Officers, AZA/WAZA Chairs and Officers, and all interested researchers. Each group should select and submit only one proposal that has been ranked as the highest funding priority and endorsed by the group.

More information and the grant application format and review criteria are available at http://www.czs.org/CZS/CBOTGrant.

The deadline for submissions is 15 July 2011.

The C V Raman International Fellowship for African Researchers for Research in India provides opportunities for African Researchers to conduct collaborative research/training for 1 to 12 months duration at universities and research institutions in India. There are different types of fellowship: postdoctoral fellowship (6 or 12 months), visiting fellowship (3 months), senior fellowship (1 month). The fellowship is open to anyone actively engaged in research at a university or a research institution in an African country. Postdoctoral fellows must have completed their PhD, visiting fellows may have a PhD , Master's or 6-10 years' working experience, senior fellows will be senior experts, scientists or professors.
For more details go to

http://www.dst.gov.in/whats_new/whats_new11/C_V_Raman_Fellowship_Prog_-_Flyer_2011.pdf

The deadline for submissions is 31 July 2011.

Abstracts

A new giant sengi?

Andanje, S., Agwanda, B.R., Ngaruiya, G.W., Amin, R. & Rathbun, G.B. 2010. Sengi (elephant-shrew) observations from northern coastal Kenya. *Journal of East African Natural History*, 99: 1-8.

The biodiversity of northern coastal Kenya is poorly understood because security problems and poor infrastructure have discouraged access to the area. However, the wooded areas in the region have great potential for harbouring unique and rare species, including sengis or elephant-shrews (Macroscelidea). Based on recent surveys of the Boni and Dodori National Reserves, which are between the Tana River and the Somali border, the ranges of the rufous sengi (*Elephantulus rufescens*) and four-toed sengi (*Petrodromus tetradactylus*) have been extended. Although the golden-rumped sengi (*Rhynchocyon chrysopygus*) of coastal Kenya south of the lower Tana River was assumed to occur in the Boni forest region, this now appears to be incorrect.

The *Rhynchocyon* east of the lower Tana River is definitely not *R. chrysopygus*, but rather resembles taxa found hundreds of kilometres to the south. Determining the taxonomic status of what may be a new form of *Rhynchocyon* will require the collection of voucher specimens and DNA tissues for detailed analyses.

Afrotherian phylogeny and conservation

Kuntner, M., May-Collado, L.J. & Agnarsson, I. 2010. Phylogeny and conservation priorities of afrotherian mammals (Afrotheria, Mammalia). *Zoologica Scripta*, 40: 1-15. doi: 10.1111/j.1463-6409.2010.00452.x

Phylogenies play an increasingly important role in conservation biology providing a species-specific measure of biodiversity – evolutionary distinctiveness (ED) or phylogenetic diversity (PD) – that can help prioritize conservation effort. Currently, there are many available methods to integrate phylogeny and extinction risk, with an ongoing debate on which may be best. However, the main constraint on employing any of these methods to establish conservation priorities is the lack of detailed species-level phylogenies. Afrotheria is a recently recognized clade grouping anatomically and biologically diverse placental mammals: elephants and mammoths, dugong and manatees, hyraxes, tenrecs, golden moles, elephant shrews and aardvark. To date, phylogenetic studies have focused on understanding higher level relationships among the major groups within Afrotheria. Here, we provide a species-level phylogeny of Afrotheria based on nine molecular loci, placing nearly 70% of the extant afrotherian species (50) and five extinct species. We then use this phylogeny to assess conservation priorities focusing on the widely used evolutionary distinctiveness and global endangeredness (EDGE) method and how that compares to the more recently developed PD framework. Our results support the monophyly of Afrotheria and its sister relationship to Xenarthra. Within Afrotheria, the basal division into Afroinsectiphilia (aardvark, tenrecs, golden moles and elephant shrews) and Paenungulata (hyraxes, dugongs, manatees and elephants) is supported, as is the monophyly of all afrotherian families: Elephantidae, Procaviidae, Macroscelididae, Chrysochloridae, Tenrecidae, Trichechidae and Dugongidae. Within Afroinsectiphilia, we recover the most commonly proposed topology (Tubulidentata sister to Afroscoricida plus Macroscelidea). Within Paenungulata, Sirenia is sister to Hyracoidea plus Proboscidea, a controversial relationship supported by morphology. Within Proboscidea, the mastodon is sister to the remaining elephants and the woolly mammoth sister to the Asian elephant, while both living elephant genera, *Loxodonta* and *Elephas* are paraphyletic. Top ranking evolutionarily unique species always included the aardvark, followed by several species of elephant shrews and tenrecs. For conservation priorities top ranking species always included the semi-aquatic Nimba otter shrew, some poorly known species, such as the Northern shrew tenrec, web-footed tenrec, giant otter shrew and Giant golden mole, as well as high profile conservation icons like Asian elephant, dugong and the three species of manatee. Conservation priority analyses were broadly congruent between the EDGE and PD methodologies. However, for certain species EDGE overestimates conservation urgency as it, unlike PD, fails to account for the status of closely related, but less threatened, species. Therefore, PD offers a better guide to conservation decisions.

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Photo Gallery

Rufous sengis in Cologne Zoo

Cologne Zoo in Germany maintains a population of rufous sengis (*Elephantulus rufescens*) which was founded in 2008 from adults wild caught in Tanzania (Olbricht & Sliwa 2010). One of the three breeding pairs of sengis is exhibited in a 10 m² enclosure (Fig 1.), together with three male red-legged sun squirrels (*Heliosciurus rufobrachium*). The enclosure is filled with a variety of items, such as rocks, cork tubes, haystacks, tree trunks, roots, and live plants of *Ficus sp.* The ground is covered with washed sand. The sengis often bask on a rock in the enclosure that is heated with an 80 Watt lamp (Fig. 2).

© A. Sliwa

Figure 1: Enclosure for rufous sengis (*Elephantulus rufescens*) and red-legged sun squirrels (*Heliosciurus rufobrachium*) in the "Hippodom" at Cologne Zoo, Germany.

© A. Sliwa

Figure 2: A breeding pair of rufous sengis with a 2-week-old offspring basking under a heat lamp.

The sengis in Cologne are fed on a diet of finely diced vegetables, live insects, crushed insects and crustaceans, and some canned cat food. Since 2008 the captive population has produced nine offspring (Fig. 3).

To our knowledge these are the only specimens of the genus *Elephantulus* which are currently presented in a zoo anywhere in the world.

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Figure 3: One-day-old rufous sengi in hay. Nest building is not known for this species.

Olbricht, G. & Sliwa, A. 2010. Elefantenspitzmäuse – die kleinen Verwandten der Elefanten? *Zeitschrift des Kölner Zoo*, 3: 135-147.

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